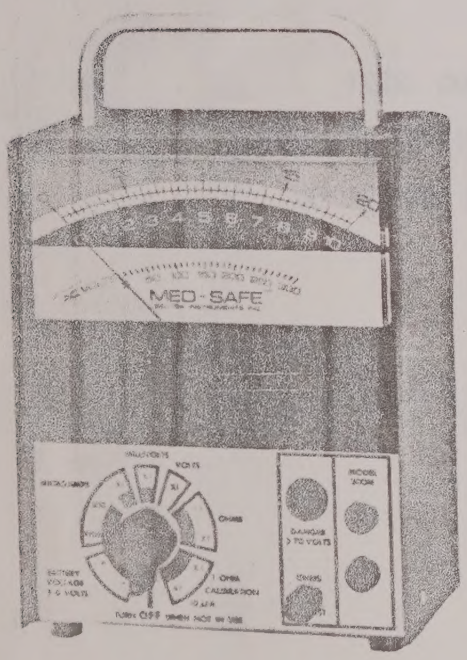
BIO-TEK INSTRUMENTS INC.

INSTRUCTION MANUAL

MODEL "200M" ELECTRICAL SAFETY ANALYZER

CALTRONIX INC.
2070 E. Henrietta Rd.
Rochester, NY 14623
(716) 359-3780



BIO-TEK INSTRUMENTS INC.
5000 SHELBURNE ROAD
SHELBURNE, VERMONT 05482
800-451-5172

MODEL 200M

ELECTRICAL SAFETY ANALYZER

INSTRUCTION MANUAL

8.0 Altering the Electrical Configuration of Wall Receptacles... 23
8.1 General..... 23
8.2 Grounding an Ungrounded Receptacle..... 23
8.3 No Ground with Normal Polarity..... 24
8.4 No Ground with Reversed Polarity..... 24
8.5 Ground with Reversed Polarity..... 24

9.0 Maintenance Instruction..... 25
9.1 General..... 25
9.2 Battery Replacement..... 25
9.3 Fuse Replacement..... 25
9.4 Microampere Calibration..... 26
9.5 Millivolt Calibration..... 27
9.6 Voltage Calibration..... 27
9.7 Ohms Calibration..... 27

10.0 Principles of Operation..... 29
10.1 General..... 29
10.2 Specifications..... 29
10.3 Schematic..... 31
10.4 Block Diagram..... 32

1.0 INTRODUCTION

1.1 GENERAL

The Model 200M Electrical Safety Analyzer is a portable, solid state instrument used to determine if an electrical or nonelectrical device is safe for use by or on an indivdual.

This instrument is designed to meet the Veterans Administration's specifications for Medical Electrical Safety Instruments, Number X-1432, the National Electrical Code and the Occupational Safety and Health Act's rules governing electrical safety for employees.

The 200M determines whether a device is safe for use by simulating the resistance a human body offers to the flow of electrical current.

This instrument may be used for carrying out all electrical safety tests on electrical devices or wall receptacles; the 200M can be safely used in the most sensitive areas since the maximum amount of physiological current used in the test is 10 microamperes into 1000 ohms.

The 200M comes complete with all of the accessories necessary to perform tests for minute leakage curents, resistance, ground, ground continuity and polarity on all standard devices and receptacles.

Since it is completely self-contained, the Model 200M can be used to perform test measurements in the field, on station or in the test and maintenance department.

As a quantitative test instrument the 200M will fit into any program designed to periodically evaluate devices for electrical deterioration. This data will permit appropriate action to be taken to prevent them from becoming hazardous while in use.

The 200M can also be used by non-technical personnel in the field or station to test devices immediately before their use.

1.2 APPLICATIONS

The 200M is designed primarily for use in those areas where electrical-powered products are constantly being tested to insure they do not fail while in use and to confirm that they are safe for use before they are put into operation.

For use by the hospital, industry, the nursing home and the electrical contractor, the 200M is used by the preventive maintenance and quality assurance departments as well as by the safety engineer.

As a quality assurance test instrument, the 200M can provide test information on a device before it is placed in service to assure the device is safe for use.

As part of a preventive maintenance program, the 200M provides long term data via periodic testing; this type of test program will provide the information needed to prevent electrical devices from breaking down in use by showing what is happening to the device because of wear and tear.

This system provides for positive control of electrical devices so they can be removed from service before they become a hazard which may cause fires, burns, shock or death; and also the time equipment is out of service because of damage, or wear and tear.

1.3 ESTABLISHING SAFETY STANDARDS

Due to the great variations in acceptable standards presently being suggested and enforced by the various agencies, organizations, and institutions, this manual does not include minimum or maximum acceptable levels after each test procedure.

Each test should be performed in accordance with the test procedures presented in this manual, but refer to your safety program's specifications to determine if the results obtained are acceptable, or if the item tested should be repaired or replaced.

If there is any doubt about the standards you should use write to the appropriate agency. If you prefer, write to Bio-Tek Instruments for this information, specifying the application and area of concern.

MODEL 200M

ELECTRICAL SAFETY ANALYZER

2.0 DESCRIPTION OF THE 200M

2.1 GENERAL

The 200M consists of an aluminum outer cover painted blue with a clear metal back plate.

The function selector and metal face are color-coded for easy correlation of test function selected and test results obtained.

The test functions color-coded blue are measured on the blue meter scale.

The volt function selector is read on the A.C. volt scale.

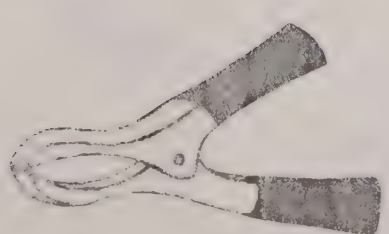
The two female jacks, color-coded red and black repectively, are receptacles for the corresponding red and black accessory leads.

The ohm adjustment knob is for calibration of the red ohm function scale.

The " danger >70 volts" indicator lamp indicates when the voltage connected to the 200M is greater than 70 volts.

2.2 ACESSORIES

The Electrical Safety Analyzer comes complete with the accessories necessary to test all normally wired electrical devices and wall receptacles.



The Ground Adapter is a small metal plastic adapter that has a male metal ground plug at one end with a female banana jack at the other.

It is used to adapt the black lead plug for use as a grounding plug for either a wall receptacle or similar device.

The Large Clamp consists of a large copper alligator clip with handles covered by plastic; one of the handles has a female banana jack at its end.

By inserting a lead into the clamp's banana jack the clamp can be used to obtain firmer eletrical contacts for either better ground or test results.

The Probe is six and one-half inches long and covered with red plastic; one end has a sharp metal point while the other has a female banana jack.

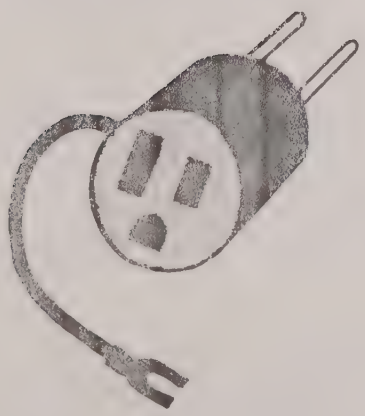
The probe fits onto the red lead plug and by using the sharp metal point on the metal parts of an electrical device a good contact can be made.

Devices that are painted can be tested by applying extra pressure on the probe's point so that the paint can be penetrated and the point will contact metal.

Two Leads are supplied and are five feet long and made of insulated wire. One lead is color-coded red and the other black.

Both leads have banana plugs at each end with contact holes located just before the plug end.

The red lead always goes into the 200M's red female jack and the black lead always goes into its black counterpart.



The NEMA Adapter, or Cheater, has a three-prong receptacle at one end with two electrical blades at the other; in the middle is a grounding wire.

When used with the 200M the adapter is used to alter a wall receptacle's electrical configuration during the testing of electrical devices.

It may also be used to convert two-blade wall receptacles into grounded-three-blade receptacles.

2.3 FUNCTIONAL INTERPRETATIONS

MICROAMPERES

The range is selected by turning the function selector to the red X1, blue X10 or Blue X100 micramp position.

Starting with the blue X100 position, read from the blue scale; if the needle does not move turn the function selector to the blue X10 position and read from the blue scale; if the needle does not move then turn the function selector to the red X1 position and read from the red scale.

All results are read in microamperes.

Example 1: If the function selector is on the red X1 microamp position and the needle indicates 7.5 on the red scale then the reading is 7.5 x 1 or 7.5 microamperes.

Example 2: If the function selector is on the blue X10 microamp position and the needle indicates 7.5 on the blue scale then the reading is 7.5 x 10 or 75 microamperes.

Example 3: If the function selector is on the blue X100 microamp position and the needle indicates 7.5 on the blue scale then the reading is 7.5 x 100 or 750 microamperes.

MILLIVOLTS

Turn the function selector to the red X1 millivolt position; read the results from the red scale in millivolts.

Example 4: If the function selector is on the red X1 millivolt position and the needle indicates 7.5 on the red scale then the reading is 7.5 x 1 or 7.5 millivolts.

VOLTS

Turn the function selector to the white X1 volt position; read the results from the white A.C. volts scale in volts.

Example 5: If the function selector is on the white X1 volts position and the needle indicates 110 on the A.C. volt scale then the reading is 110 x 1 or 110 volts.

OHMS

The range is selected by turning the function selector to the red X.1 or X1 ohm position.

Starting with the red X.1 position, read from the red scale; if the needle goes off of the scale turn the function selector to the red X1 position and read from the red scale.

Example 6: If the function selector is on the red X.1 ohm position and the needle indicates 10 on the red scale then the reading is 10 x .1 or 1.0 ohm.

Example 7: If the function selector is on the red X1 ohm position and the needle indicates 10 on the red scale then the reading is 10 x 1 or 10 ohms.

3.0 OPERATIONAL INSTRUCTIONS

3.1 GENERAL

ALWAYS KEEP THE RED AND BLACK LEADS INSERTED INTO THE 200M's RED AND BLACK JACKS FOR ALL MEASUREMENTS.

Before rotating the function selector through any ohm position, always remove the probe from contact with the electrical device.

Turn the function selector to the OFF position whenever the 200M is not in use.

If any of the 200M's calibration and test results are not correct do not proceed with any further testing until corrective action has been taken and the 200M is operating properly.

For the most accurate results keep the 200M in an upright position while reading test results.

Always make firm contacts to insure proper results.

Always perform the Battery Check, Microamp Calibration, and Ohm Calibration instructions each day before the 200M is used to perform any other tests.

Always zero the ohm scale according to Section 3.7 before any resistance measurements are made.

3.2 UNPACKING INSTRUCTIONS

Unpack shipping carton.

Check contents of shipping carton for the following:

200M Leakage Detector

Long Red Probe

Large Clamp

Ground Adapter

NEMA Adapter

Leads (red and black with banana plugs on each end.

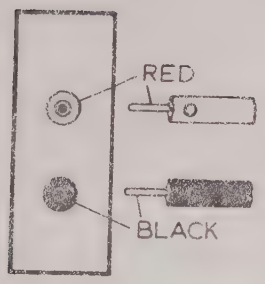
Inspect the 200M carefully for damage.

Examine case and meter face.

Check security of handle.

If any damage is noted, report it to the carrier for claims adjustment and contact Bio-Tek Instruments for your replacement.

3.3 ASSEMBLY



Take the red lead and place it in the red jack.

Take the black lead and place it in the black jack.

3.4 BATTERY CHECK

1. Turn the function selector to the blue (-) battery check position.
2. Read the results on the blue scale in volts.

ACTION: If the results are greater than six (6) volts continue to the next step.

If the results are less than six (6) volts see Section 9.0 for corrective action.

3. Turn the function selector to the blue (+) battery check position.
4. Read the results on the blue scale in volts.

ACTION: If the results are greater than six (6) volts the batteries are operational.

If the results are less than six (6) volts see Section 9.0 for action.

3.5 MICROAMP CALIBRATION CHECK

1. Turn the function selector to the red 10uA calibration position.
2. Read the results on the red scale in microamps.

ACTION: If the results are between 9.5 and 10.5 microamps the 200M is properly calibrated for microamperes.

If the results are not in this range, and the batteries are operational, see Section 9.0 for corrective action.

3.6 OHM CALIBRATION CHECK

1. Hold the red and black banana plugs located at the end of the red and black leads firmly together.
2. Turn the function selector to the red X.1 ohm position (NOT the 1 ohm calibration position.)

3. Using the ohm adjustment knob, adjust the needle to read zero on the red scale.

4. Turn the function selector to the red X.1 ohm calibration position.

5. Read the results on the red scale and multiply by 0.1; the answer is in ohms.

ACTION: If the results are between 0.9 and 1.1 ohm the 200M is properly calibrated for ohms.

If the results are not in this range see Section 9.0 for corrective action.

3.7 ZEROING THE OHM SCALE

1. Hold the red and black banana plugs located at the end of the red and black leads firmly together.

2. Turn the function selector to the red ohm position to be used. (NOT the 1 ohm calibration position.)

3. Using the ohm adjustment knob, adjust the neddle to read zero on the red scale.

ACTION: If the needle is on zero, the ohm scale is zeroed.

If the needle will not go to, or stay on zero see Section 9.0 for corrective action.

4.0 INSTRUCTIONS FOR TESTING WALL RECEPTACLES

4.1 GENERAL

This section covers the proper test techniques necessary to insure that a wall receptacle or extension cord has undergone proper testing prior to its use for electrical devices.

The following tests using the Electrical Safety Analyzer are meant to be carried out in sequence for each individual receptacle; if at any time a receptacle is tested and found to be above your maximum safety specification discontinue testing of that receptacle, follow your procedure for tagging defective receptacles and continue on to the next receptacle.

4.2 TYPES OF RECEPTACLES

This analyzer may be used for testing all common types of receptacles. For those receptacles of unusual configuration additional accessories are necessary to perform the electrical safety tests.

All two-blade receptacles that do not provide a position for grounding must be adapted with a NEMA Adapter. See section 8.2 for applying the NEMA Adapter to this type receptacle.

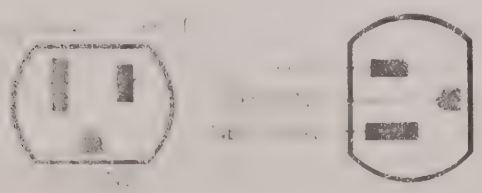
Receptacles used in explosive chemical or electrically sensitive areas usually are of the Twist Lock Type. To test this type of receptacle a Bio-Tek Model No. NF23-1 Adapter is necessary; see Section 7.2.

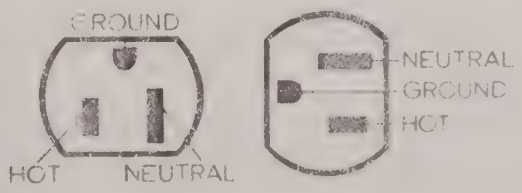
The standard grounded receptacle that can be used with three-prong plugs can be tested without any additional accessories.

4.3 POSITIONS OF THE RECEPTACLE

All receptacles should always have a common electrical configuration.

Before performing the following tests carefully examine the receptacle to be tested and find its counterpart in the following illustrations.





By comparing the above illustrations with the receptacle to be tested it can be determined which of the blade openings of the test receptacle should be "hot" and "neutral".

4.4 VISUAL INSPECTION

1. Examine the receptacle for cracks, damage, or missing parts.

ACTION: If the receptacle appears to be in satisfactory condition continue to next step.

If the receptacle is not acceptable according to your safety specifications tag accordingly and move on to next receptacle to be tested.

2. Examine the receptacle for the type of power cord plug it will accept.

ACTION: If this receptacle will accept a three-prong grounded plug and meets your safety specifications continue to next step.

If this receptacle can only handle the two-blade, non-grounded plug, but does meet your safety specifications see Section 8.0 for action that is necessary to continue testing.

If this receptacle does not meet your safety specifications tag accordingly and move on to next receptacle to be tested.

4.5 TESTING FOR POWER, GROUND AND POLARITY

1. Keep function selector in "OFF" position.

2. Insert the black lead plug into the ground adapter.

3. Insert the ground adapter into the grounding hole of the receptacle under test.

4. Insert the red lead plug into the probe.

5. Insert the probe into the"hot" blade opening of the receptacle.

6. Observe for the danger indicator lamp to light.

ACTION: If the lamp does light perform step 6A.

If the lamp does not light by-pass step 6A and go on to step 7.

6A. Insert the probe into the neutral blade opening of the receptacle.

ACTION: If the lamp does not light the receptacle is correctly wired for power, ground and polarity; move on to the next receptacle to be tested.

If the lamp does not light the receptacle is improperly wired; follow your procedure for improperly wired receptacles and continue to next receptacle to be tested.

7. Insert the metal tip of the probe into the neutral blade opening of the receptacle.

8. Observe for the danger indicator lamp to light.

ACTION: If the lamp does not light there is no power or ground to that receptacle. Follow you safety procedure.

If the lamp does light the polarity of the receptacle is reversed; follow your safety procedure for receptacles with reversed polarity and then continue to next receptacle to be tested.

8.0 TESTING FOR VOLTAGE

This test series is to be performed only after it has been determined that the receptacle has power, is grounded and has proper polarity.

1. Turn the function selector on the 200M to the white A.C. volts position.

2. Insert the black lead plug into the ground adapter.

3. Insert the ground adapter into the grounding hole of the receptacle under test.

4. Insert the red lead plug into the probe.

5. Insert the probe into the hot blade opening of the receptacle.

6. Observe for a reading on the white A.C. volt scale.

ACTION: Read the results as A.C. volts.

REMOVE probe from blade opening and turn function selector to the OFF position.

9.0 TESTING FOR GROUND CONTINUITY OR EQUIPOTENTIAL GROUNDS BETWEEN WALL RECEPTACLES

This test series is to be performed only after each receptacle has been found to be grounded, with power and normal polarity.

1. Hold the red and black banana plugs located at the end of the red and black leads firmly together.

2. Turn the function selector to the red X.1 ohm position (NOT the calibration position.)

Using the ohm adjustment knob, adjust the needle to read zero on the red scale

ACTION: The needle must be on zero to proceed to the next step.

If the needle will not go to, or stay on zero, see Section 9.0 for corrective action.

4. Insert the black lead plug into the ground adapter.

5. Insert the ground adapter into the ground opening of one of the receptacles under test.

6. Insert the red lead plug into the probe.

7. Insert the probe into the ground opening of one of the other receptacles under test.

8. Observe the results on the red scale multiplying the reading by 0.1 and read in ohms.

ACTION: If the resistance (ohms) is within the acceptable limits of your safety standards record results and continue to next receptacle.

If the ohms reading is greater than that which is acceptable tag the receptacle accordingly and proceed to next receptacle to be tested.

At the completion of this test series turn the function selector to the OFF position.

7.0 INSTRUCTIONS FOR TESTING ELECTRICAL DEVICES

7.1 GENERAL

This section covers the proper procedures necessary to insure that an electrical device has undergone proper testing prior to its use by or on an individual.

The following tests using the Model 200M are meant to be done in sequence for each individual device; if at any time a device is tested and found to be above your maximum safety specifications discontinue testing of that device, follow your procedure for tagging defective electrical devices and continue on to the next device to be tested.

Devices under test should not be in use for normal operation while testing is being performed.

7.2 ALTERING THE ELECTRICAL CONFIRURATION

Most test standards require the tests performed on electrical devices be done under all possible electrical configurations so that "worse case conditions" can be determined and in every operational mode.

A device must be tested with ground and normal polarity, ground and reversed polarity, no ground and normal polarity, and no ground with reversed polarity.

Since most electrical devices and wall receptacles are grounded with normal polarity, a method has to be employed that can simulate the other conditions. The standard procedure is to use a NEMA Adapter as presented in Section 8.0.

If a device has an on-off power switch then each of the following tests involving wall receptacles should be performed separately with power off and then power on.

Each device must be tested in the following configurations, using a NEMA Adapter.

POWER SWITCH ON	POWER SWITCH OFF
Normal polarity and ground	Normal polarity and ground
Reversed polarity and ground	Reversed polarity and ground
Normal polarity and no ground	Normal polarity and no ground
Reversed polarity and no ground	Reversed polarity and no ground

No device can be considered tested unless every metal part or knob which is accessible has been tested and found to be acceptable.

IMPORTANT: If at any time during these test procedures the red danger light comes on, IMMEDIATELY disconnect the device's power cord plug from the wall receptacle and remove the device from service; AVOID contact with any part of the device's chassis while the device is plugged into the receptacle.

VISUAL INSPECTION

This test series to be conducted with the electrical device disconnected from any power source or wall receptacle.

1. Examine the cord's plug for cracks, frayed insulation or bent blades.

2. Examine the power cord from the plug to the chassis for cuts or cracks in the insulation.

3. Examine the connection of the power cord to the chassis for cuts or cracks in the insulation.

ACTION: If all of the above appear to be in satisfactory condition continue to the next step.

If any of the above do not meet your safety specifications tag accordingly and move on to the next device to be tested.

TESTING THE GROUND PIN

1. Insert the black lead jack into the clamp.

2. Insert the red lead jack into the probe.

3. Attach the clamp firmly to the probe tip.

4. Turn the function selector to the red X.1 ohm position (NOT the 1 ohm calibration position.)

5. Using the ohm adjustment knob, zero the meter on the red scale.

6. Attach the clamp firmly to the ground pin of the power cord.

[illegible] the probe, make firm contact with the device's metal parts that are painted but attached to the chassis; if painted apply pressure to penetrate to the metal.

Observe the readings on the red scale, multiply by 0.1 and report the results in ohms.

ACTION: If the resistance (ohms) is within acceptable limits of your safety specifications record results and continue to next test procedure.

If the ohms reading is greater than that which is acceptable, tag the device accordingly and proceed to the next device to be [illegible].

NOTE: Remove clamp from ground pin and if further testing is not to be conducted immediately turn the 200M's function selector to the OFF position.

5.8 TESTING FOR LEAKAGE CURRENT

This test series is to be performed only after it has been determined that the wall receptacle to be used has power, is grounded and has normal polarity and that the device's power plug has been tested according to Section 5.4.

No device can be considered satisfactorily tested unless every metal part or knob, which is accessible, has been tested. All devices should be tested under all possible electrical configurations, so that "worst case conditions" can be tested.

1. Plug the device into the wall receptacle.

2. Insert the black lead into the ground adapter.

3. Insert the ground adapter into a previously tested receptacle's grounding hole.

4. Insert the red lead into the probe.

5. Turn the function to the X100 microamp position.

6. Take the probe and make firm contact with the chassis of the device under test.

7 Observe results on the blue scale; multiply by 100 and read in microamps.

ACTION: If there is no reading go to the next step.

If there is a reading, check your safety standards to see if the results are acceptable and proceed accordingly; you may then go to the next test procedure.

8. Holding the probe firmly against the contact point, turn the function selector to the blue X10 microamp position.

9. Observe results on the blue scale; multiply by 10 and read in microamps.

ACTION: If there is no reading go to the next step.

If there is a reading, check your safety standards to see if the results are acceptable and proceed accordingly; you may then go to the next test procedure.

10. Holding the probe firmly against the contact point, turn the function selector to the red X1 microamp position.

11. Observe results on the red scale; read directly and in microamps.

ACTION: If there is no reading and each exposed metal part connected to the chassis is tested then there is no detectable leakage current.

If there is a reading, check your safety standards to see if the results are acceptable and proceed accordingly.

[illegible] FOR MILLIVOLTS

1. Turn the function selector to the red X1 millivolt position.

2. Leave the ground adapter in the receptacle's grounding hole.

3. Keep the probe firmly in contact with the chassis of the device.

4. Observe the results on the red scale; read directly and in millivolts.

ACTION: If there is a reading check your safety standards to see if the results are acceptable and proceed accordingly.

NOTE: Remove probe from contact with the chassis and turn the function selector to the OFF position.

BEFORE PROCEEDING ANY FURTHER BE SURE THAT YOU HAVE TESTED EACH INDIVIDUAL INSTRUMENT IN EACH POSSIBLE ELECTRICAL CONFIGURATION TO INSURE THAT THE WORSE CASE CONDITIONS HAVE BEEN TESTED.

6.0 INSTRUCTIONS FOR TESTING PROBES, ELECTRODES, ETC.

6.1 GENERAL

Many electrical devices have leads which are used to monitor, stimulate, or test for varying properties and are not unlike the leads used with this Electrical Safety Analyzer.

They may be passive by not supplying any electrical current, or they may be active by using current to perform some function. In all cases each and every lead must be tested.

The electrical device that they are used with must be tested first; once the device is found to be safe when they may be tested.

6.2 TESTING FOR LEAKAGE CURRENT TO GROUND

1. Attach the electrodes, etc. to the electrical device in the normal manner as though for routine use.
2. Plug the device into a previously tested wall receptacle.
3. Insert the black lead of the Electrical Safety Analyzer into the ground adapter.
4. Insert the ground adapter into a receptacle's grounding hole.
5. Insert the red lead plug into the probe.
6. Make firm contact between the probe and a electrode.
7. Turn the function selector to the blue X100 microamp position.
8. Follow the instructions for testing for leakage current in Section 5.5 starting with step # 7.

6.3 TESTING FOR LEAKAGE CURRENT BETWEEN ELECTRODES

1. Attach the electrodes, etc. to the electrical device in the normal manner as though for routine use.
2. Plug the device into a wall receptacle.
3. Insert the black lead plug of the Electrical Safety Analyzer into the [illegible]
4. Insert the red lead plug into the probe.
5. Attach the clamp firmly onto an electrode, etc.
6. Make firm contact between the probe and another electrode.

7. Turn the function selector to the blue X100 microamp position.

8. Follow the instructions for testing for leakage current in Section [illegible] beginning with step # 7.

NOTE: Do not proceeding be sure each electrode is tested.

7.0 INSTRUCTIONS FOR TESTING EXPLOSION PROOF ISOLATED POWER SYSTEMS

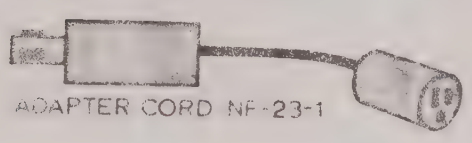
7.1 GENERAL

In some institutions, especially hospitals, there are areas and rooms designated as sensitive areas. Generally this is due to either the danger of fire and explosion from gases or because of the absolute need for control of the electrical power used to operate devices.

To eliminate and control these hazards, explosion-proof twist lock wall receptacles and power cord plugs are used.

To test these areas, special adapters are required for both the receptale and the power cord plug; these adapters are available as accessories from Bio-Tek Instruments.

7.2 TYPES OF ADAPTERS



ADAPTER CORD NF-23-1

The NF23-1 has a male explosion-proof twist lock on one end with a regular female three-prong receptacle at the other.

The male explosion-proof twist lock is inserted into the wall mounted, explosion-proof; twist lock receptacle leaving the female three-prong receptacle available so that the test may be conducted.

ADAPTER CORD NF-23-2

The NF23-2 has a female exlplosion-proof, twist lock on one end with a regular male three-prong plug at the other.

The female explosion-proof twist lock is inserted into the male explosion-proof twist lock plug from the electrica device, leaving the male three-prong plu available so that the tests may be condu ted.

INSTRUCTION FOR TESTING MONITOR ALARMS

1. Insert the male explosion-proof twist lock of the NF23-1 Adapter into the wall receptacle.

2. Place the ground adapter onto the black lead.

   the ground adapter into the ground hole of the adapter receptacle.

   rt the red lead into the probe.

   [illegible] to the OFF position.

4. Insert the red probe into the hot slot of the receptacle.

ACTION: A light and/or alarm should sound.

If not, follow your safety procedures.

7. Remove probe from the hot slot and place it in the neutral slot.

ACTION: A light and/or alarm should be visible or audible.

If not, follow your safety procedures.

7.4 INSTRUCTIONS FOR TESTING ELECTRICAL DEVICES

Move the device to be tested into an area that has standard grounded receptacles that can take standard three-prong plugs.

2. Insert the female explosion-proof twist lock of the NF23-2 Adapter into the explosion-proof twist lock plug on the device's power cord.

3. Follow the test procedures for testing electrical devices found in Section 5.0 using the male plug end of the NF23-2 Adapter.

7.5 INSTRUCTIONS FOR TESTING ELECTRICAL DEVICES PERMANENTLY INSTALLED IN ISOLATED POWER AREAS.

1. Insert the male explosion-proof twist lock of the NF23-1 Adpater into the wall receptacle.

2. Place the ground adapter onto the black lead.

3. Plug the ground adapter into the ground hole of the adapter receptacle.

4. Insert the red lead plug into the probe.

5. Turn the Electrical Safety Analyzer on microamperes X100.

6. Touch all electrical devices in the room with the probe making firm electrical contact.

7. Proceed as in Section 5.5 starting with step # 7.

8. All devices must be checked for leakage current in the "ON" and "OFF" position.

9. The ground of all devices must be checked.

10. Remove the ground adapter from the ground hole.

11. Hold the probe tip and ground adapter firmly together.

12. Turn the function switch to ohms X.1.

13. Zero the meter by turning the ohms adjust knob.

14. Place the ground adapter into the ground hole of the receptacle of the adapter.

15. Make contact with the chassis of each device permanently installed and record the resistance reading (ohms) with the maximum safe level established and proceed accordingly.

ALTERING THE ELECTRICAL CONFIGURATION OF WALL RECEPTACLES

GENERAL

It has already been noted in previous sections that the wall receptacle may have to have its electrical configuration altered.

This may be accomplished with the NEMA Adapter, provided with the Electrical Safety Analyzer.

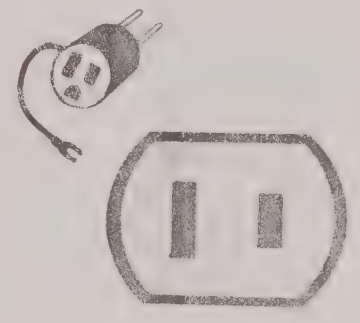
GROUNDING AN UNGROUNDED RECEPTACLE

1. Holding the NEMA Adapter with its blades facing the receptacle and the ground pin of the opposite end of the Adapter down.

2. Insert the blades into the receptacle.

3. Attach the Adapter's ground cord to the screw on the receptacle's plate.

4. Test the Adapter for ground, polarity, and power according to Section 4.5.



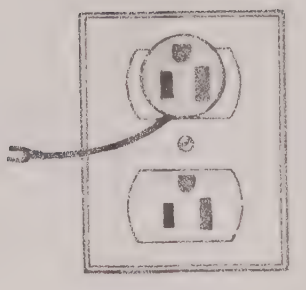
ACTION: If the Adapter has ground, power, and normal polarity, this receptacle is acceptable.

If there is reversed polarity then remove the Adapter from the receptacle, leaving the ground pin attached to the screw, and turn 180° and reinsert.

If there is no ground then seek an alternative point; be sure that the ground adapter is in firm contact with the plate screw.

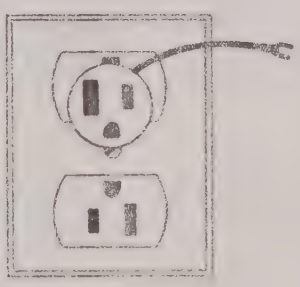
NO GROUND WITH NORMAL POLARITY

1. Follow the procedure in Section 8.2 for grounding an ungrounded receptacle but do not attach the Adapter's grounding cord to the plate's screw.



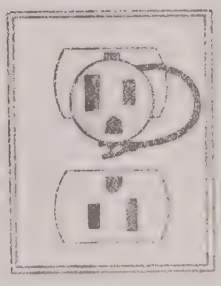
NO GROUND WITH REVERSED POLARITY

1. Follow the procedure for grounding in Section 8.3 but rotate the Adapter 180°.



GROUND WITH REVERSED POLARITY

1. Follow the procedure in 8.4 but attach the Adapter's ground cord to the plate's screw.



9.0 MAINTENANCE INSTRUCTIONS

9.1 GENERAL

Proper operation of the 200M requires that it always be in calibration, the batteries have sufficient voltage for testing, and that the fuse be operational.

Whenever the (+) or (-) battery check reads less than six (6) volts replace both of the batteries.

If the ohm scale isn't reading properly check the fuse.

No recalibration instructions are included in this section. It is recommended that the instrument be returned to the factory for recalibration if the user does not possess the necessary equipment for proper recalibration.

9.2 BATTERY REPLACEMENT

Whenever either of the two (2) Mallory TR146X Batteries indicate a potential of less than six (6) volts both batteries must be replaced.

1. Remove the two screws from each side of the 200M.
2. Gently lift the blue outer case from the meter support box and place it on a soft surface.
3. Unsnap each of the battery connectors.
4. Slide the batteries out of their snap-clip holders.
5. Insert two new Mallory TR146X Batteries, or their equivalent.
6. Firmly snap the battery connectors onto the batteries.

Test both the (+) and (-) battery checks to be sure that installation is correct.

Screw the blue outer back onto the meter support box.

9.3 FUSE REPLACEMENT

The .5 amp 3AG fuse protects the ohm circuit and will blow whenever the function selector is in any of the ohm's position and the 200M comes in contact with 110 volts.

1. Remove the two screws from each side of the 200M.

Gently lift the blue outer case from the meter support box and place it on a soft surface.

Looking in from the front, examine the fuse on the right side (located on the rear panel of the meter support box.)

4. If the fuse filament is not intact, gently move it with a screw driver.

NOTE: The fuse on the left is a spare; gently remove it with a screw driver and insert it in the active fuse holder.

5. Screw the blue outer case back onto the meter support box.

MICROAMPERE CALIBRATION

The battery voltage must be greater than six (6) volts and both batteries must be within one volt of each other according to a volt-ohm meter.

1. Turn the function selector to red X1 microamp position.

2. Placing a shorting bar across the red and black lead openings.

3. Zero the meter with potentiometer 1 of PCB Diagram.

NOTE: Meter must read zero in both open circuit and short circuit imput before proceeding.

4. Remove shorting bar.

5. Put 10 microamps ($\pm$ .2%into the 200M)

6. Adjust meter to exactly 10 microamps with potentiometer 4 of PCB Diagram.

7. Replace shorting bar.

8. Turn function selector to red X1 microamp position.

NOTE: Meter must read zero, if it does continue to next step; if not, repeat steps 3-5.

9. Remove shorting bar.

10. Turn function selector to blue X10 microamp position.

11. Put 50 microamps ($\pm$ .2%) into the 200M.

12. Adjust meter to exactly 50 microamps with potentiometer 3 of PCB Diagram.

13. Turn function selector to blue X100 microamp position.

14. Put 500 microamps ($\pm$ .2%) into the 200M.

15. Adjust meter to exactly 500 microamps potentiometer 2 of PCB Diagram.

16. Replace shorting bar.

17. Turn function selector to red X1 microamp position.

18. Meter must read zero, if it does continue to next step; if not, repeat steps 3

19. Remove shorting bar

19. Turn function selector to red 10 microamps calibration position.

20. Adjust meter to 10 microamps with potentiometer 5 of PCB Diagram.

NOTE: If the meter will not read 10 microamps by adjusting the potentiometer, replace the battery located on the top center of the PCB with a Mallory RM1R 1.35 volt battery.

21. Place function selector on blue battery check position.

NOTE: Meter must read between 8 and 9 volts with new batteries.

9.5 MILLIVOLT CALIBRATION

The millivolt function is automatically calibrated when the microamp calibration is performed satisfactorily.

9.6 VOLTAGE CALIBRATION

The volt function is automatically calibrated when the microamp calibration is performed satisfactorily.

9.7 OHMS CALIBRATION

The battery voltage must be greater than six (6) volts and both batteries must be within one volt of each other according to a volt-ohm meter.

Check the fuse to be sure it is operational; if blown replace it with a ½ amp 3AG fuse before proceeding.

References to potentiometer numbers are indicated in the P.C. Board Illustration

Put a 1000 ($\pm$ 5%) ohm resistor across the input of the 200M.

Turn the function selector to the red X.1 ohm position.

Measure the voltage across the resistor with a high impedance volt meter.

If the voltage is between 9 and 10 millivolts continue to next step; if not, resistor R2 must be changed.

If resistor R2 is replaced the new resistor must be adjusted to read between 9 and 10 millivolts.

If the voltage is less than 9 millivolts R2 must be decreased.

If the voltage is above 10 millivolts R2 must be increased.

Values for R2 are 1K, 1.5K, and 2K.

[illegible] test can be done using another 200M to measure the output current; [illegible] must be between [illegible]

4. Short pins 5 and 6 together and short to ground.

5. Adjust potentiometer number 7 so that the meter reads as close to zero as possible. Remove the shorting clips.

6. Connect leads to be used in calibration to the Model 200M.

7. Short the leads together.

8. Adjust ohms adjust knob on front panel so meter reads zero.

9. Connect a 1 ohm resistor ± 1% to the leads.

10. Adjust potentiometer number 8 so the meter reads zero.

11. Check the reading at .5 ohms ± 1% and 1.5 ohms ± 1 % and at 2 ohms ± 1%. Adjust potentiometer number 8 so that the reading is as accurate as possible on all these settings.

12. Turn function selector to red X1 ohms position.

13. Short leads together.

14. Zero meter by adjusting ohms adjust knob on front panel.

15. Connect 10 ohms ± 1% to the leads.

16. Adjust potentiometer number 6 until the meter reads 10.25 ohms.

17. Short the leads. Zero the meter by adjusting the ohms adjust potentiometer.

18. Repeat 14, 15, and 16, five times because potentiometer number 6 alters the zeroing.

19. Check the 1 ohm calibration by placing function switch on ohms X.1, shorting the leads, and zeroing the meter using the ohms adjust knob.

Switch the function switch to 1 ohm calibrate position. While holding the leads together, the meter must indicate 1 ohm ± .1 ohm.

PLACE NAIL POLISH OR EQUIVALENT ON THE ADJUSTED POTENTIOMETERS INSIDE THE MED SAFE MODEL 200M TO PREVENT THEM FROM MOVING.

PRINCIPLES OF OPERATION

GENERAL

[illegible] Model 200M mimics the physiological impedance of the human [illegible] and detects AC and DC current flow through this impedance by [illegible] of high gain operational amplifiers. The absolute values of the AC and DC currents are added by means of summing circuits and read out directly on the meter. A feedback loop encloses all circuits to insure stability. Extensive current and voltage safety circuits are provided to prevent damage to the precision amplifying networks. Absolute reliability of the instrument is insured by a battery check which tests the batteries and a self-calibration check that insures proper operation of the Model 200M Electrical Safety Analyzer.

Model 200M was designed to enable personnel to evaluate the safety of all electrical devices.

SPECIFICATIONS

Range	Accuracy % (Full Scale)	Accuracy
Microamps X1	± 2%	± .4 microamps
Microamps X10	± 2%	± 2 microamps
Microamps X100	± 2%	± 20 microamps
Millivolts	± 2%	± .4 millivolts
[illegible]	± 2%	± [illegible] volts
[illegible]	± 5%	± .1 ohm
[illegible]	± 5%	± [illegible] ohm

[illegible] (approx.) 3 lbs.

[illegible] 15 cm x 17.1 cm x 15.5 cm

[illegible] x 6 3/4" x 6"

[illegible]

Microamps	1000 ohms
Millivolts	1000 ohms
Ohms	300K ohms

[illegible] Current in Ohms Mode

Will accept maximum DC into 1000 ohms.

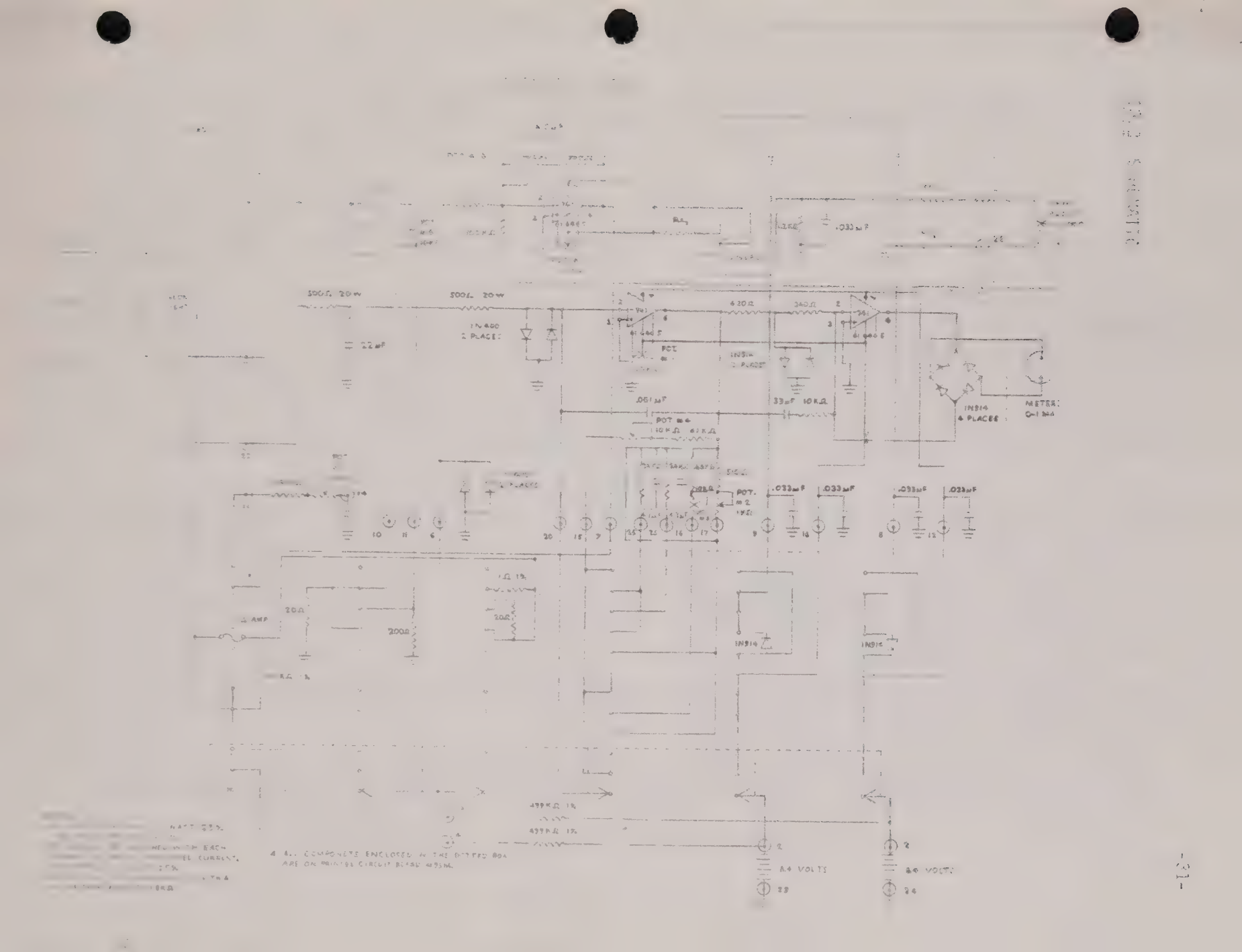
[illegible] response.

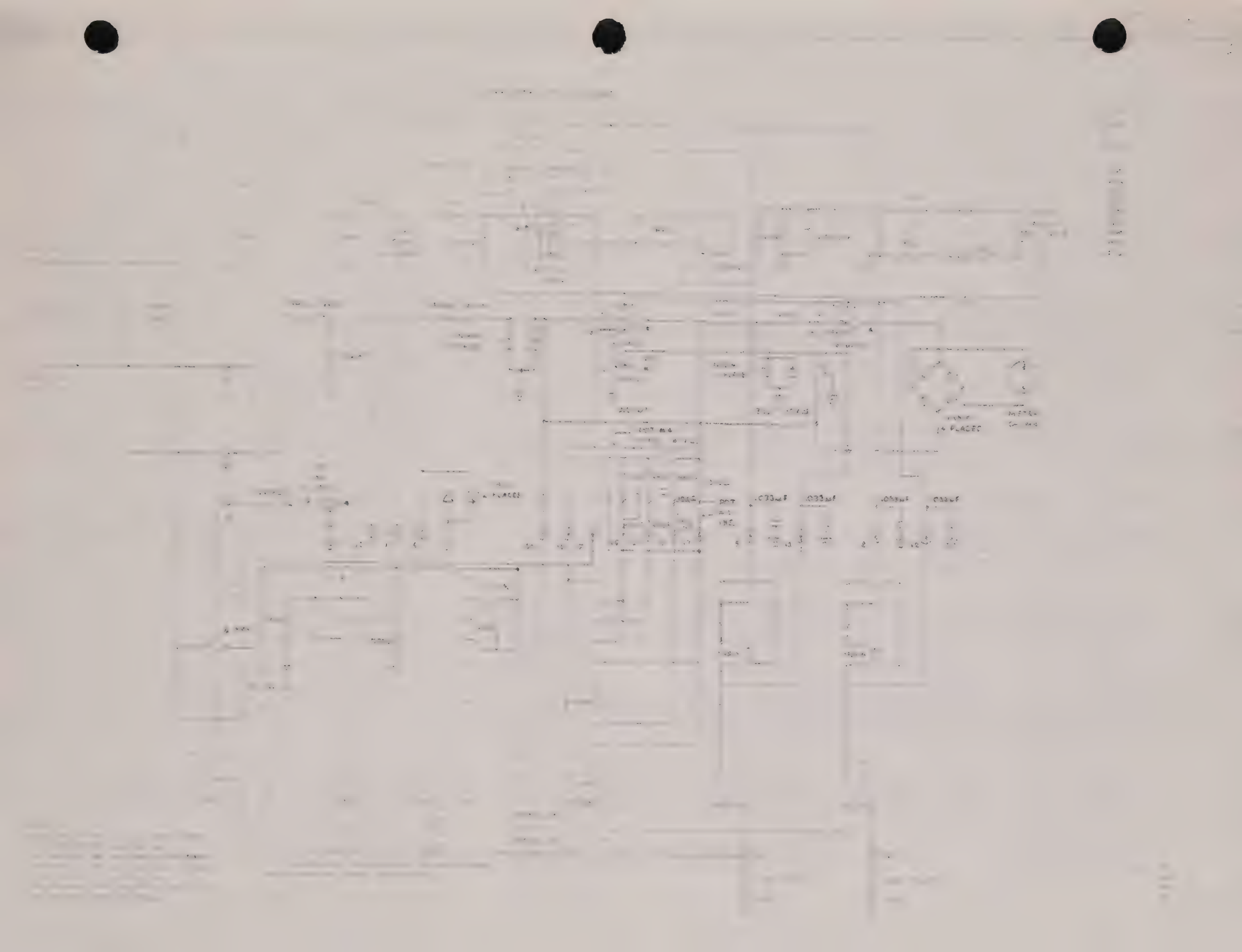
[illegible] 1000 Hz. according to WWV response curve.

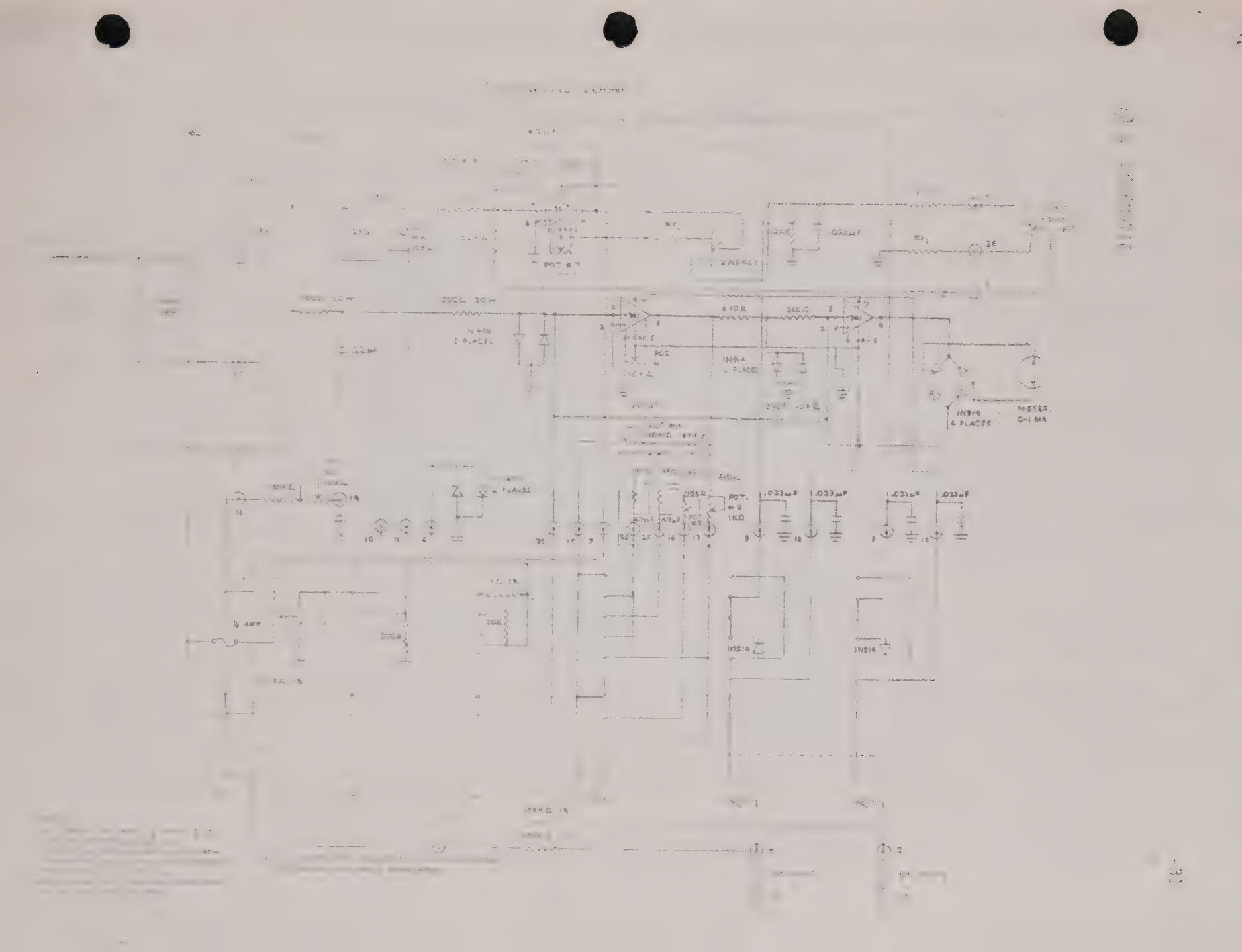
[illegible]

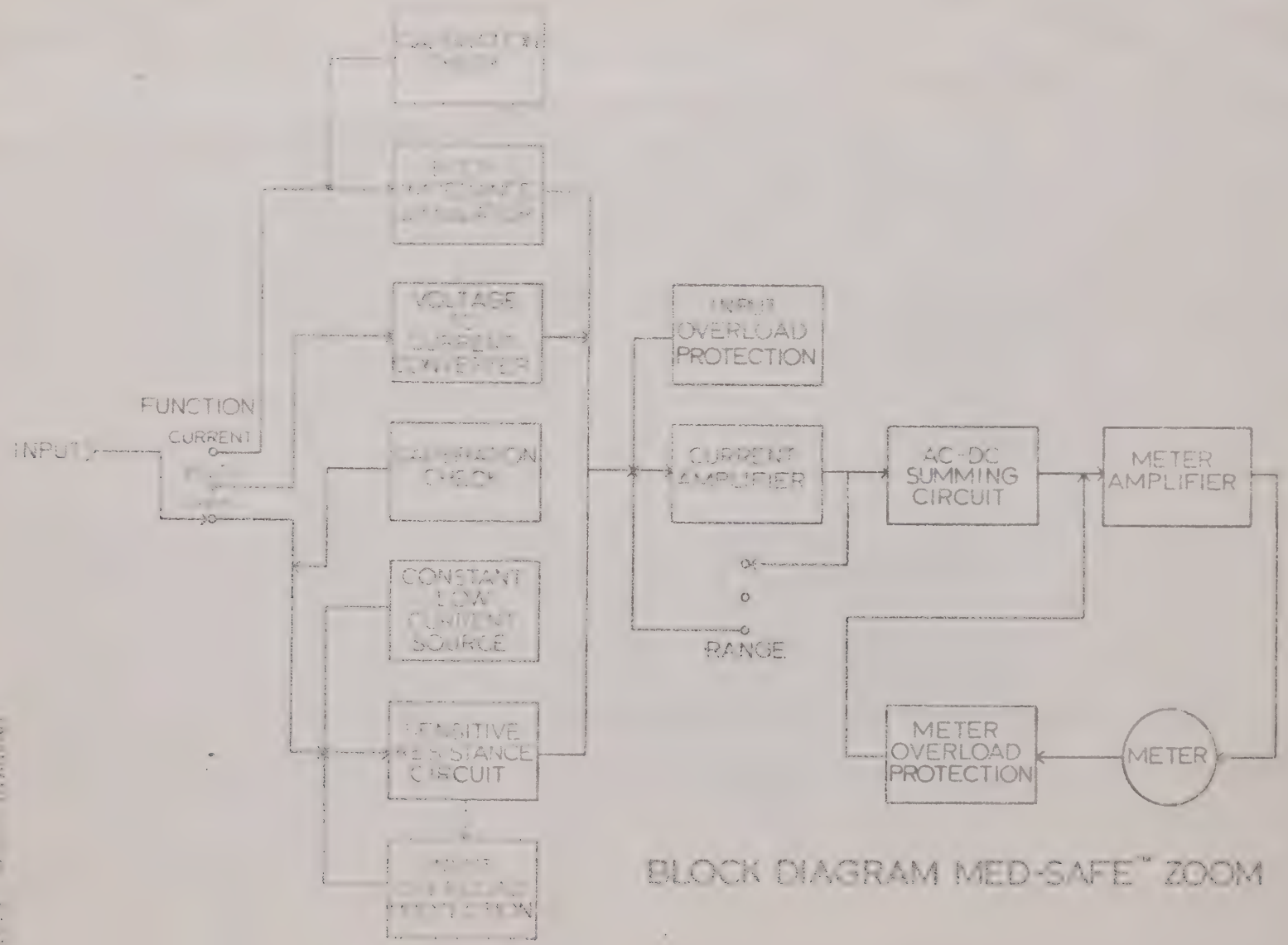
[illegible] 24AX or Equivalent

[illegible]

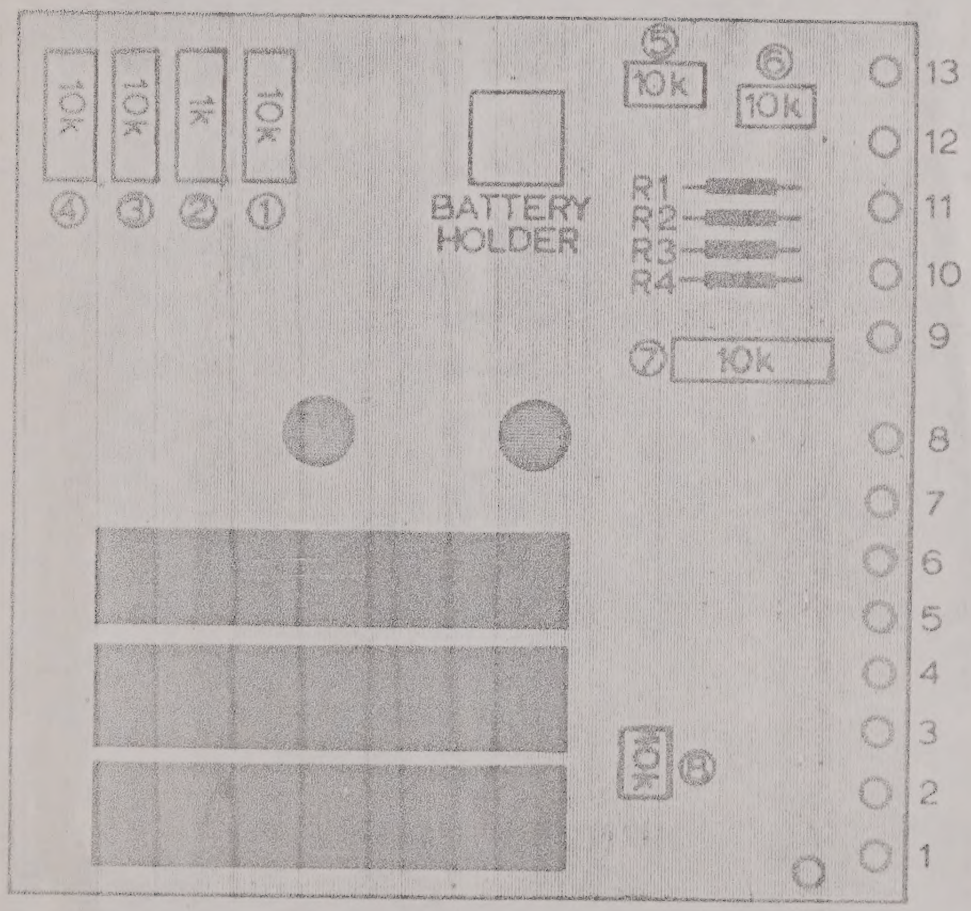

500Ω 20W
500Ω 20W
.22mF
IN400
2 PLACES
620Ω
240Ω
.033mF
POT
IN914
2 PLACES
.061mF
33mF 10KΩ
POT
10KΩ
IN914
4 PLACES
METER
0-1mA
.033mF
.033mF
.033mF
.033mF
1Ω 1%
20Ω
200Ω
20Ω
4 AMP
IN914
IN914
499KΩ 1%
499KΩ 1%
44 VOLTS
44 VOLTS
4 ALL COMPONENTS ENCLOSED IN THE DOTTED BOX
ARE ON PRINTED CIRCUIT BOARD #953M.



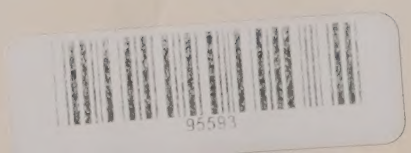




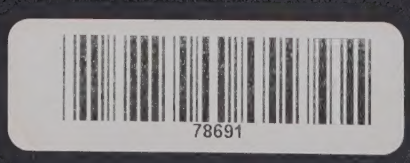
BLOCK DIAGRAM MED-SAFE™ ZOOM



PRINTED CIRCUIT BOARD



100%
RECYCLED



100%
RECYCLED
61640
DUO-TANG
MADE IN U.S.A.